SYSTEM AND METHOD FOR DISPLAYING AN IMAGE STREAM

FIELD OF THE INVENTION

The present invention relates to a method and system for displaying and/or
5   reviewing image streams.

BACKGROUND OF THE INVENTION

An image stream may be assembled from a series of still images and
displayed to a user.   The images may be created or collected from various
10   sources.   For example, a known in-vivo imaging system which includes a
swallowable capsule, may, for example, capture images of a lumen such as the
gastrointestinal (GI) tract and may transmit them to an external recording device.
Large numbers of images may be collected for viewing and, for example, combined
in sequence. An image stream of, for example, 40 minutes in length, containing for
15   example about 4,800 frames, may be available to, for example a health
professional for review. Other numbers of frames or lengths may be used. In one
embodiment, a health professional may, for example, use the images to diagnose
pathological conditions of the GI tract, and, in addition, the system may provide
information about the location of these pathologies.   Pathology, if present may
20   typically be found in only a few locations along the long traverse of the GI tract, and
therefore in a small percentage of the recorded images.

In general, if possible, a user may try to set the streaming rate to the
highest rate where the user can quickly review the image stream without missing
important information that may be present in any of the images included in the
25   stream. The rate at which a user can effectively review an image stream may be
limited by a physiological averaging above which certain details in individual
images displayed in the stream may be physiologically filtered out.

SUMMARY OF THE INVENTION

30   The system and method according to some embodiments of the present
invention may allow an image stream to be viewed while emphasizing images that

may be of interest (e.g., images of pathologies). Thus, a user may quickly locate selected images of interest out of a lengthy image stream and an efficient and short view time may be provided. Other uses or benefits of an image display method according to some embodiments of the invention may exist.

5   In one embodiment, a system and method are provided for displaying an image stream, such that multiple images from the image stream are displayed substantially simultaneously in a time slot. Substantially simultaneously may include simultaneously. As such a single-frame stream display may be converted to a multi-frame stream display that may be shorter in viewing time. In a further
10   embodiment of the invention, the spatial position of the images displayed substantially simultaneously in each time slot may be variably adjusted based on a predetermined criterion. For example, the spatial order or position of the images displayed substantially simultaneously in each time slot may correspond to a degree of variation of each image compared to a selected or generated reference
15   image. In a further example, images displaying pathological looking tissue may be positioned away from images displaying healthy looking tissue. In one embodiment of the invention, images from a group of images displayed substantially simultaneously, containing a high degree of variation as compared to the other images in the group may be displayed in a spatial position where a viewer
20   may typically draw his/her eyes first. In certain embodiments, the images may be collected from an autonomous capsule traversing the GI tract.

BRIEF DESCRIPTION OF THE DRAWINGS

          The present invention will be understood and appreciated more fully from
25   the following detailed description taken in conjunction with the drawings in which:
          Figure 1A shows a schematic diagram of an in-vivo imaging system according to one embodiment of the present invention;
          Figure 1B shows a schematic diagram of a monitor display according to one embodiment of the present invention;
30   Figure 2 shows a portion of a display according to an embodiment of the present invention;

Figure 3 shows a flow chart describing a method for spatially positioning a plurality of image frames displayed substantially simultaneously, according to an embodiment of the present invention;

Figure 4 shows a flow chart describing a method for spatially positioning a plurality of image frames displayed substantially simultaneously, according to another embodiment of the present invention;

Figure 5 shows a portion of a display according to a second embodiment of the present invention;

Figure 6 shows an exemplary flow chart describing a method for combining multiple image streams into a single image stream according to an embodiment of the present invention; and

Figure 7 showing an exemplary flow chart for adjusting the stream rate of the multi-frame stream according to one embodiment of the present invention.

It will be appreciated that for simplicity and clarity of illustration, elements shown in the figures have not necessarily been drawn accurately or to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity, or several physical components may be included in one functional block or element. Further, where considered appropriate, reference numerals may be repeated among the figures to indicate corresponding or analogous elements.

DETAILED DESCRIPTION OF THE INVENTION

In the following description, various aspects of the present invention will be described. For purposes of explanation, specific configurations and details are set forth in order to provide a thorough understanding of the present invention. However, it will also be apparent to one skilled in the art that the present invention may be practiced without the specific details presented herein. Furthermore, well-known features may be omitted or simplified in order not to obscure the present invention.

Reference is made to Fig. 1A, which shows a schematic diagram of an in-vivo imaging system according to one embodiment of the present invention. In an exemplary embodiment, the system may include an imaging device 40, such as for example a capsule having an image sensor 46, for capturing images, an illumination source 42, for illuminating the body lumen, a transmitter 41, and an antenna 44, for transmitting images and possibly other information to, for example, a receiving device. Typically, the imaging device may correspond to embodiments described in U.S. Patent No. 5,604,531 to Iddan et al., and to embodiments described in published application WO01/65995 to Glukhovsky et al., both of which are incorporated herein by reference in their entirety, but in alternate embodiments there may be other types of imaging devices. In one embodiment, an imaging device may include more than one image sensor. The image sensors may, for example be arranged at either end of device 40, or at the same end of the device, in slightly different positions or different angles. A device which includes a plurality of image sensors, is described for example, in International Publication Number WO 02/054932 entitled "System and Method for Wide Field Imaging of Body Lumens" which is assigned to the common assignee of the present invention and which is hereby incorporated by reference. Each image sensor may capture in vivo images and transmit the in vivo images via the transmitter 41 or via separate transmitters. The separate in vivo image streams captured may be combined into a single in vivo image stream based on image comparison between the two streams or based on other criteria.

In another embodiment of the invention, device 40 may include, for example, sensors 43 that may be a sensor other than image sensors such as for example, temperature sensor, pressure sensor, blood sensor, pH sensor, ultrasound sensor, oxygen sensor, other sensor, and/or more than one sensor. Data sampled from sensor 43 may, for example, be transmitted via transmitter 41 or via separate transmitters.

Typically, located outside the patient's body in one or more locations may be an image receiver 12, a data processor 14, and an image monitor 18. Image receiver 12 may typically include an antenna or antenna array 15 and an image receiver storage unit 16. Data processor 14 may include, for example, a processor 19 and a storage unit 21. In one embodiment of the present invention, storage unit 21 may include, for example, an image database 22. Image monitor 18 may display, *inter alia*, images transmitted by, for example, device 40. Typically, data processor 14 and monitor 18 may be part of a personal computer or workstation, which includes standard components such as processor 19, a memory, a disk drive, and input-output devices, although alternate configurations are possible. Data processor 14 may typically, as part of its functionality, acts as a controller controlling the display of the images. Image monitor 18 may typically be a conventional video display, but may, in addition, be any other device capable of providing images or other data and may be of any size monitor including small palm type monitors or large projection size monitors. The image monitor 18 presents the image data, typically in the form of still and streaming image frames, and in addition may present other information. In an exemplary embodiment, the various categories of information are displayed in windows. Other displaying formats may be used. Multiple monitors may be used to display image and other data. The images captured by the imaging system may be of any suitable shape including for example circular, square, rectangular, or hexagonal, oval etc.

In operation, image sensor 46 may capture images and may send data, for example, image data to transmitter 41, which may transmit data to receiver 12 using, for example, electromagnetic radio waves. Other types of data other than image data may be transmitted. Receiver 12 may transfer the data to receiver storage unit 16. Image data stored in storage unit 16 may be transferred to the

data processor 14 and/or the data processor storage unit 21. For example, the receiver 12 or receiver storage unit 16 may be taken off the patient's body and may be connected to the personal computer or workstation that may include the data processor 14 via a standard data link, *e.g.*, a serial, parallel, USB, or wireless

5 interface of known construction. The data, for example, image data may then be transferred from the receiver storage unit 16 to a database 22 that may be included in data processor storage unit 21. Typically, the image stream is stored as a series of images in the image database 22, which may be implemented in a variety of known manners. Data processor 14, including dedicated software may analyze the

10 data and provide the analyzed data to the image monitor 18, where a user may view the image data and/or other data. In one embodiment of the invention, more than one image stream may be captured from more than one image sensor. In this embodiment, data processor 14 may be used to combine the separate image streams into one image stream. The combining of the two or more image streams

15 may be for example, based on comparing images from each image stream, based on time of image capture, or based on other criteria or more than one criterion. Other configurations may allow for real time viewing where, for example, device 40 or receiver 12 may transmit data in real time to data processor 14 for real time viewing on monitor 18.

20   Typically, according to one embodiment, an in-vivo imaging device, such as for example device 40, collects a series of still images as it may traverse the GI tract. In one embodiment of the present invention, device 40 may collect a large volume of data, as it may take several hours to traverse the GI tract, and may record images at a rate of, for example, two images every second, resulting in the

25 recordation of, for example, thousands of images. The image recordation rate (or frame capture rate) and recordation duration may be varied.

            Typically, the data captured and transmitted by the device 40 may be digital color image data, although in alternate embodiments other image formats may be used and data other than and/or in addition to image data may be

30 transmitted. In an exemplary embodiment, each frame of image data may include, for example, 256 rows of 256 pixels, each pixel may include, for example, bytes for color and brightness, according to known methods. In other embodiments, image

data may include more a less pixels and each pixel may include other information or other number of bytes. Other suitable methods of recording image data may be used. Typically, images may be stored sequentially in, for example, data processor storage unit 21. In other embodiments, image data and/or other data may be
5   stored in receiver storage 16.

Typically, data processor storage unit 21 may store a series of images captured by device 40, for example, as it moves through a patient's GI tract. The series of images may be combined consecutively to form an image stream. When viewing the image stream, the user may be typically presented with one or more
10 windows on monitor 18; in alternate embodiments multiple windows need not be used and only the image stream may be displayed. Reference is now made to Fig. 1B showing a schematic diagram of display 18. In an embodiment where multiple windows are provided, for example, an image window 50 may display the image stream or still portions of that image stream. A sensor window 53, may display a
15 concurrent stream of data from sensors other than image sensors, for example, ultrasound, pressure, temperature, blood, oxygen, and/or a pH sensor. Other sensors may be used. A location window 52 may display information on the location of the imaging device, for example, device 40, at the time of capturing the image frames being displayed. A control window 54 may include buttons or other
20 controls that may be used to alter the display of the image; for example, stop, play, pause, capture image, step, fast-forward, rewind, or other. Such controls may be activated by, for example, a pointing device such as a mouse or trackball. Typically, the image stream may be frozen to view one frame or one set of frames, speeded up, or reversed; sections may be skipped; or any other method for
25 viewing an image may be applied to the image stream. Other windows may be included.

While the following discussion relates to the case where data from a device 40 is stored for later use, the system and method of the present invention may be used with systems allowing for real time viewing of image data.

30 Furthermore, while typically the components accepting, processing and displaying the image data are contained within a workstation system or PC, other systems may be used, and other (e.g., distributed) components may perform such

image accepting, processing and displaying. For example, a large projection type monitor may be used to view a plurality of images substantially simultaneously.

In one embodiment of the present invention, device 40 may have more than one imager. Multiple image streams may result from multiple imagers being in the same device, or possibly by splitting one image stream into multiple images streams. Combining of image streams may be performed by for example a processing device, e.g. processor 19. Reference is now made to Fig. 6, showing an exemplary flow chart describing a method for combining multiple image streams into a single image stream. Each image sensor may capture in vivo images and transmit the in vivo images via the transmitter 41 or via separate transmitters. Alternately, one image stream may be split (e.g., every other image may be placed into one of two image streams, etc.). The separate image streams obtained from the multiple image sensors may be stored (step 610). Comparison may be made between the frames captured from the separate image streams (step 620). In other embodiments of the invention, the separate image streams may not be stored in their entirety before comparison is made. Based on the comparison, frames from each of the separate image streams may be slotted into a single image stream (step 630). Other methods besides or in addition to comparing frames may be used to combine multiple image streams. The separate image streams may be combined such that frames displaying similar scenery are slotted in close proximity to each other. As such, the multiple image streams may be displayed in a variable order and/or manner. Other suitable criteria may be used as well.

In one embodiment, the imaging window (e.g. monitor 18) may display a multi-frame stream where multiple images are displayed substantially simultaneously in each time slot, thereby reducing the viewing time. In one embodiment, processor 19 may determine spatial positioning of each of the frames displayed substantially simultaneously. For example, in one embodiment, the original image stream may be divided into, for example, separate image streams displayed substantially simultaneously in single time slots. Various methods may be used to separate an original image stream into a plurality of image streams to be streamed substantially simultaneously. In one example, images from the

original image stream may be divided into, for example, 16 subset image streams such that, for example, during the first time slot, the first 16 images of the original image stream may be displayed substantially simultaneously, and in the second time slot the next 16 images of the original images stream may be displayed substantially simultaneously, etc. Other number of image streams may be used and some frames in the original stream may be skipped. In alternate embodiments, the images may be separated, for example, placed in different files or memory blocks in processor 14. In one embodiment, each resulting image stream may include a separate subset of images from the original image stream; in alternate embodiments, the images from each resulting image stream may overlap. In another embodiment of the invention, images of the original image stream may be divided between the separate images streams in alternate manners that may be suitable. Typically, the spatial positioning and/or order of the frames, for example, the frames obtained from corresponding separate image streams may vary for each time slot.

In one embodiment, images from the original image stream may be simply directed to the proper screen position at viewing time, and the image stream may, for example, not actually be separated in separate image streams. In such embodiments, a different number of images may be displayed substantially simultaneously for every time slot. Typically, the spatial positioning of one or more frames displayed substantially simultaneously may be in a variable order, e.g. an order other than the chronological order that the frames were captured. In one embodiment, each time slot may display all image frames captured from a specified region. For example, the first time slot may include all frames captured in the esophagus, the second time slot may display all images captured in the stomach, etc. In an alternate embodiment the same number of image frames may be displayed in each time frame.

Fig. 2 depicts a portion of a display according to an embodiment of the present invention. The display 200 may include, for example, 16 image frames displayed substantially simultaneously in a single time slot (210A-240D). In an exemplary embodiment, the windows or viewing areas, 210A, 210B etc., may be close together, with a minimum of blank or black space between the frames, and

typically may be displayed in matrix form, to allow a viewer to see the entirety of the frames without substantially moving his eyes. Other suitable spatial arrangements may be used.

The spatial order or position of the image frames displayed in a single time slot may be adjusted and/or varied based on for example, computations made by processor 19. The spatial order of the image frames displayed substantially simultaneously may correspond to the chronological order in which the images may have been captured, may correspond to an alternate predetermined criteria, to more than one predetermined criteria, or other criteria of interest. In one embodiment of the invention the spatial order or position of the frames displayed may be based on a predetermined criteria, and/or criteria of interest. In one embodiment of the invention, the image frames displayed in a single time slot may be spatially positioned based on a predetermined criterion of, for example color variation. Other criteria, such as focusing, lighting, blood detection, etc. may be used.

An exemplary algorithm is listed in Fig. 3. Referring to block 318, a set of image frames to be displayed substantially simultaneously in a single time slot may be selected. In some embodiments of the present invention, the set of images to be displayed substantially simultaneously in a single time slot may be selected based on for example predetermined criteria. For example, images displaying specified features e.g. color scheme, may be selected to be displayed substantially simultaneously during a single time slot. Other suitable criterion may be used, e.g. focusing, lighting, blood detection, shape features, etc. Normalization or adjustment of lighting may be performed on the image frames to be displayed (block 320). This may be performed to reduce any color variation due to shadowing, variation in lighting intensity, or variation in lighting and image sensor properties when, for example, image frames may be captured from more than one image sensor. Subsequently, a reference image may be generated based on the image frames to be displayed (330). In one embodiment of the invention, the reference image frame may be, for example, an image representing the average or sum of the image frames to be displayed substantially simultaneously in a single time slot. In another embodiment of the present invention, the reference image

may be, for example, a selected image frame that may have some known properties, an image selected or generated from a previous time slot, or other suitable images. In one embodiment of the invention, the reference image may represent a typically healthy looking tissue. In step 340, the image frames being displayed in the time slot, may be compared to the generated image. The comparison may be based on comparing sections of images or may be based on comparing whole images. In one example, images displaying pathology may show a high degree of variation with respect to the reference image, for example when the reference image may represent a typically healthy tissue. A score may be given to each image based on the comparison performed (block 350). In another embodiment of the invention, image frames to be displayed in a single time slot may be compared to more than one reference image and receive more than one score. The spatial position of the image frames displayed and/or other suitable parameters, e.g. size may be based on the scores they were assigned (360). For example, according to one embodiment pictures having similar scores may be positioned where a viewer may typically draw his/her eyes first, e.g., at a corner of the display.

Other post processing methods may be included as well to differentiate between images that may display, for example, pathology and images that may display, for example, bubbles, content, or other variations through the GI tract, which may not be associated with pathology or other criteria of interest. In another embodiment of the present invention, the generated image may represent an average image generated from the entire original image stream, from a predetermined section of the original image stream, or from image streams taken from a pool of volunteers. In another example the generated and/or pre-selected image may represent a pathology or specific information that is being sought in the plurality of image streams. As such, images with the lowest degree of variation with respect to the reference image may be representative of the images of interest. Other algorithms may be used as well. As an example, images detected as displaying blood may be a criterion of interest. Algorithms for blood detection have been previously described in US Application Number 10/097,096 filed on March 14, 2002, assigned to the common assignee of the present invention and

hereby incorporated by reference. In another embodiment of the invention other criteria besides or together with color variation may be used. For example, shape variation may be used as a criterion to help identify polyps in the GI tract. Variation above or below a certain threshold based on a selected or generated image may

5 be used. The threshold may be adjusted to increase or decrease sensitivity. Other suitable criteria may be used as well.

In yet another embodiment of the invention, the criteria of interest that may determine the spatial order of the image frames in each time slot, and the number of images displayed per time slot may be based on readings concurrently or

10 substantially concurrently obtained from sensors other than image sensor, for example the spatial positioning of image frames displayed substantially simultaneously in a single time slot may be based on reading obtained from one or more non-image sensors mentioned herein.

In some embodiments of the present invention, in-vivo sensors readings

15 may be used as input, for example, to processor 19, to sort spatial positioning of frames in each time slot. Other suitable methods of determining spatial positioning may be used. Reference is now made to Fig. 4 showing a flow chart for sorting image frames displayed substantially simultaneously in a single time slot. In step 510, images to be displayed substantially simultaneously may be selected.

20 Corresponding sensor readings from one or more non-image sensors (e.g. temperature sensor, pressure sensor, blood sensor, pH sensor, ultrasound sensor, oxygen sensor, etc.) may be selected (step 520). For example, temperature readings recorded during the time of capturing the image frames selected in step 510 may be used. Images selected in step 510 may be sorted (step 530) based on

25 the corresponding sensor data selected in step 520, in for example ascending or descending order. Other methods of sorting may be implemented. In one embodiment of the present invention, sorting may be based on reading of more than one sensor and may be based on image analysis, or image analysis as well as sensor readings. In another embodiment of the present invention, images may

30 also be sorted based on for example a one or zero output of a sensor, so that all images corresponding to a one output may be grouped together and all images corresponding to a zero output may be grouped together. Images corresponding

to sensor readings passing a defined threshold may be tagged (540). Such images may be emphasized during display as may be described herein.

Typically, increasing the number of image frames displayed substantially simultaneously in a single time slot, may allow for a processing method such as the
5   examples described in Fig. 3 and Fig. 4 to single out, for example, a relatively small number of frames showing pathology from, for example, a relatively large number of frames showing typically healthy looking tissue. Increasing the number of images displayed in a single time slot may decrease the emphasis on small variation in, for example, healthy tissue while possibly increasing the emphasis on
10 large variations that may appear in for example, pathological tissues. In addition, increasing the number of images displayed in a single time slot may decrease the viewing time and/or the length of the displayed image stream.

In one embodiment of the invention, image frames that may have showed, for example, a high degree of variation may be positioned, for example, on monitor
15 18, in a location where the user may mostly likely glance first, and image frames that may have shown, for example, a low degree of variation may be positioned, for example, where the user may most likely to glance last. In one embodiment of the present invention, it may be assumed that the user may scan the matrix of images starting at the upper left hand corner. In this embodiment, image frames that may
20 be of interest, for example showing a high degree of variation with respect to frames, for example, representing healthy looking tissue, may be positioned in the upper left hand corner, starting with for example frame 210A (Fig. 2). Image frames that may be of least interest, for example, images showing a low degree of variation with respect to images representing healthy looking tissue, may be
25 positioned in the lower right hand corner, ending with for example with frame 240D (Fig. 2). Frames may be arranged by descending order of degree of variation. The progression from frame 210A to frame 240D may be by row (e.g. 210A, 210B, ..., 220A, 220B, ...230A, ..240D), by column (e.g. 210A, 220A, ..., 210B, 220B, ...210C, ...240D), or radially (e.g. 210A, 210B, 220B, 220A, 210C, 220C, 230C,
30 230B, ...240D). Other suitable progression series may be used. In another embodiment of the present invention, image frames that may be of interest, for example showing a high degree of variation, may be positioned in the center of the

image window, at a height, for example, 2/3 above the bottom, while images showing a low degree of variation may be positioned in the periphery of the image window. The progression from image frames showing a high degree of variation to image frames showing a low degree of variation may be a spiral shaped. Spiral
5 progressions may be clockwise spiral progressions, or counter-clockwise progressions. Other suitable criteria may be used besides degree of variation.

Other suitable image frame arrangements may be used as well. For example, image frames in single time slot that meet a particular criteria of interest above a defined threshold may in one embodiment of the present invention, be
10 grouped together for emphasis, by for example, fusion at the borders to form a single entity, or emphasized by, for example, highlighting, inserting a border around grouped image frames, etc. For example, in Fig. 2 image frames 210A and 210B may be emphasized by border 299. Other number of frames or types of grouping may be used.

15 In one embodiment of the invention, images displayed substantially simultaneously may be of different sizes or shapes. In one example, specific images from the group of images displayed substantially simultaneously may be enlarged or displayed in a larger size so as to emphasize them. Reference is now made to Fig. 5 showing as an example, 46 image frames displayed substantially
20 simultaneously. In one embodiment of the invention, image frames having for example, the highest degree of variation according to a specified criteria are placed in, for example the center (with respect to, for example, the horizontal positioning), at a height 2/3 above the bottom. In one example, images with variation above a predetermined threshold may be grouped together and displayed in larger frames
25 such as frames 401, 402, 403, 404, and 405, 406. Other images below the specified threshold, for example, might be displayed in smaller frames such as, for example, frames 407 to 446. The sensitivity of this grouping may be adjusted by increasing or decreasing the defined threshold. The threshold may be adjusted by the user or for example by an algorithm adjusting the threshold based on a defined
30 maximum and minimum number of large frames to be displayed concurrently in a single time slot along with other criteria.

In another embodiment of the invention, the larger frames may be positioned at the top left corner. In yet another embodiment of the present invention different size frames may be positioned in other suitable arrangement. As such, a large number of images may be reviewed by a user, such as a health

5   professional, while only emphasizing the typically few images most likely to contain information of interest. The typically large majority of images less likely to contain information of interest may be reviewed at a quick glance. In one embodiment of the invention, a user may pause the image streaming when identifying an image of particular interest. As such the user may examine more carefully the image or

10   images of interest and the images taken around the vicinity of the image of interest. The order that the images may be shown substantially simultaneously may be altered to show images for example in a chronological order. Other suitable features may be used as well to aid in the analysis of the images obtained.

In one embodiment of the invention, lighter images may be in general

15   positioned in the upper part of the image window 50, (Fig. 1B) while in general darker images may be positioned in the lower end of image window 50. As such the continuity between subsequent time slots may be enhanced for easier viewing of a stream. In other embodiments of the present invention, other suitable parameters may be used for determining the order of the image frame.

20   Typically, if normally a single-frame stream may be displayed at a certain rate, a multi-frame stream may be displayed at a slower rate. For example if typically a single-frame stream may be displayed at 20 frames per second, a multi-frame stream may be displayed for example at 5 or less frames per second. In such a case the overall viewing time may be up to four times less than the original

25   single-frame stream viewing time. Other suitable viewing rates and ratios between single-frame stream and multi-frame stream viewing time may be used. In one embodiment of the invention, the viewing rate or other viewing parameters of the multi-frame stream may be adjusted based on the content of the frames displayed in each time slot and based on the transition of sequential time slots. For example,

30   time slots including frames that may meet a criterion of interest may be displayed at a slower rate than time slots that may not include frames that meet a criterion of interest. In another example, the viewing rate may be reduced where there may be

a large variation in the color content in the transition between neighboring time slots. In yet another embodiment of the invention, a user may adjust the frame rate as well as the number of frames displayed substantially simultaneously.

Reference is made to Fig. 7 showing an exemplary flow chart for adjusting
5   the stream rate of the multi-frame stream according to one embodiment of the present invention. In one example, a set of frames to be displayed in a single time slot may be examined (step 710). If one or more frames meet a predetermined criterion (step 720), such as a criterion of interest, the stream rate may be adjusted (step 750), for example, reduced. This may help to further emphasize frames that
10   may be of interest. In another example, the viewing rate may be reduced where there may be a large variation in the color content in the transition between neighboring time slots. Frames displayed in neighboring time slots may be compared (step 730). If there is a large variation in frames displayed in neighboring time slots, for example a large variation in color content or texture, the
15   stream rate may be reduced (step 740). If there is no significant variation and no frames meeting a criterion of interest, the stream rate may be maintained (step 760). In yet another embodiment of the invention, a user may adjust the frame rate as well as the number of frames displayed substantially simultaneously.

In an exemplary embodiment, the user may switch modes, for example
20   between viewing the images as one stream and viewing the images as a plurality of streams using a control such as a keystroke, mouse, or on-screen button. The user may control the plurality of streams in a manner similar to the control of a single stream, for example by using on screen controls. In an alternate embodiment, only one mode may be offered to the user. In yet an alternate
25   embodiment of the invention, a user may select a mode of only viewing images meeting a defined criterion of interest.

In some embodiments, each image may be displayed with different post-processing. For example, one image may be subject to certain filtering or manipulation (e.g., red or green filtering, contrast enhancement, brightness
30   alteration) and the other image may be subject to different or no filtering or manipulation. In one embodiment two or more images in a plurality of streams displayed substantially simultaneously may be fused together, for example, at the

borders and may be displayed as a single entity. As such, a user may comfortably and concurrently incorporate information shown in each of the images while avoiding the distraction that may be caused by the typically sharp contrast between connecting edges or between the images and the background color which may

5   appear between the images when the images are spaced apart. According to some embodiments fusing borders between independent images may be accomplished by, for example, one or more post processing algorithms known in the art, including but not limited to, smoothing convolution, mirroring, overlapping, linear or non-linear fade-out fade-in, truncation, linear shape distortion, non-linear

10   shape distortion, normalization or intensity, or other suitable post-processing.

It will be appreciated by persons skilled in the art that the present invention is not limited by what has been particularly shown and described hereinabove. Rather the scope of the invention is defined by the claims that follow: